Host Parasite Relationship

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OBJECTIVES

- Define core terms important in host-parasite relationship.
- Know host response to parasite invasion (specific and non-specific responses).
- Know important examples of primary and secondary pathogens.
- Recognize the differences between virulence and pathogenicity and know how virulence is measured.
- Recognize the transmissibility of pathogens.
- Describe the attributes of pathogenicity and recall examples.
- State Koch's postulates

Host-Parasite Relationship

- Human host is normally in contact with many microorganisms (*normal flora*), only a small number of these microorganism (primary and opportunistic pathogens) can cause disease.

- Host-parasite relationships is characterized by fighting the organism to invade the body and the body defending itself by protective measures.

Host-Parasite Relationship can be discussed under:

A) Pathogenicity

B)Normal flora

(see previous lecture)

Definitions

- **Pathogenicity** : the ability of an microorganism to cause disease.
- **Pathogen** : a microorganism having the capacity to cause disease in a particular host.
- **Disease** : is the end product of an infectious process

Definitions- cont,.

Resistance:

- The ability of the host to prevent establishment of infection by using its defense mechanisms.

Susceptibility:

- Lack of resistance to organism and establishment of disease.
- **Transmissibility:**

The ability to **spread** from one host to another. This enables the microorganism to maintain continuity of its species in the event of death of original host.

- **Infection** is simply invasion of cells and multiplication by microorganisms without tissue destruction.

  Virulence is an ability to invade and destroy tissue to produce disease.

  Virulence is measured by the *Lethal dose 50* ***(LD50)*** which is the number of organisms or mg. of toxins that will kill 50% of susceptible lab. animal (usually mice) when injected into such animal. When the LD 50 is small, the microorganism is considered highly virulent and when it is high the organism is said to be of low virulence.

Pathogens

Can be divided according to the degree of Pathogenecity into:

a) **Primary pathogens:**

Cause disease in non- immune host to that organism.

e.g. - *Bordetella species*

- *Mycobacterium tuberculosis*

b) **Opportunistic pathogens**:

Having low pathogenicity and infect people with low immunity. eg. *Pseudomonas*

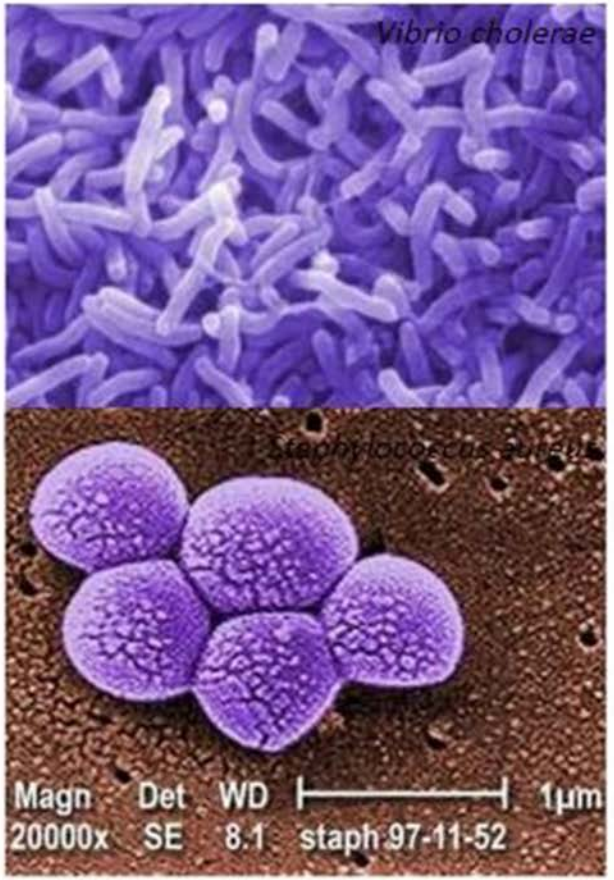
True vs. Opportunistic Pathogen

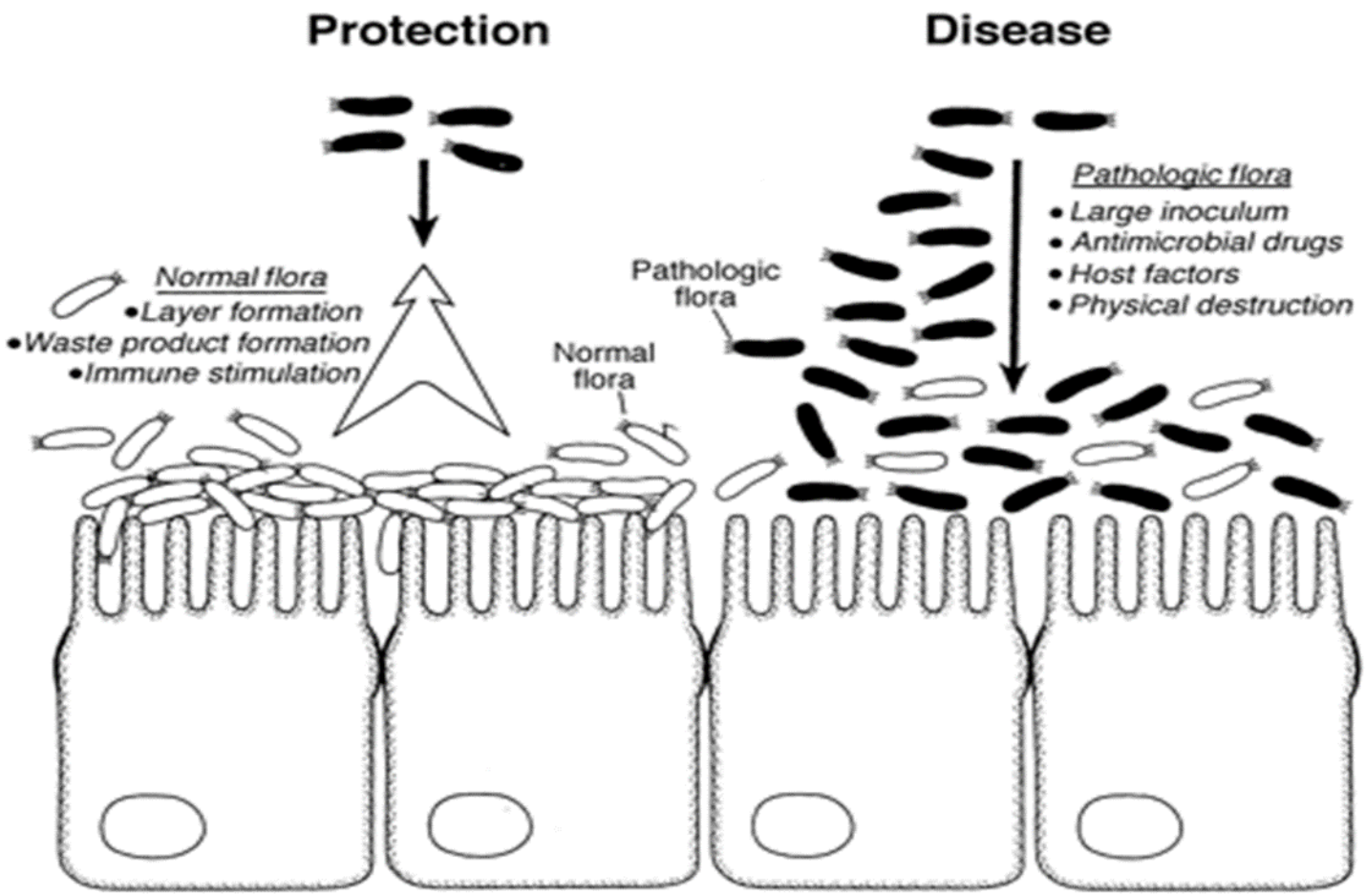
True pathogen

- Causes disease in healthy individuals
- Associated with a specific and recognizable disease

Opportunistic pathogen

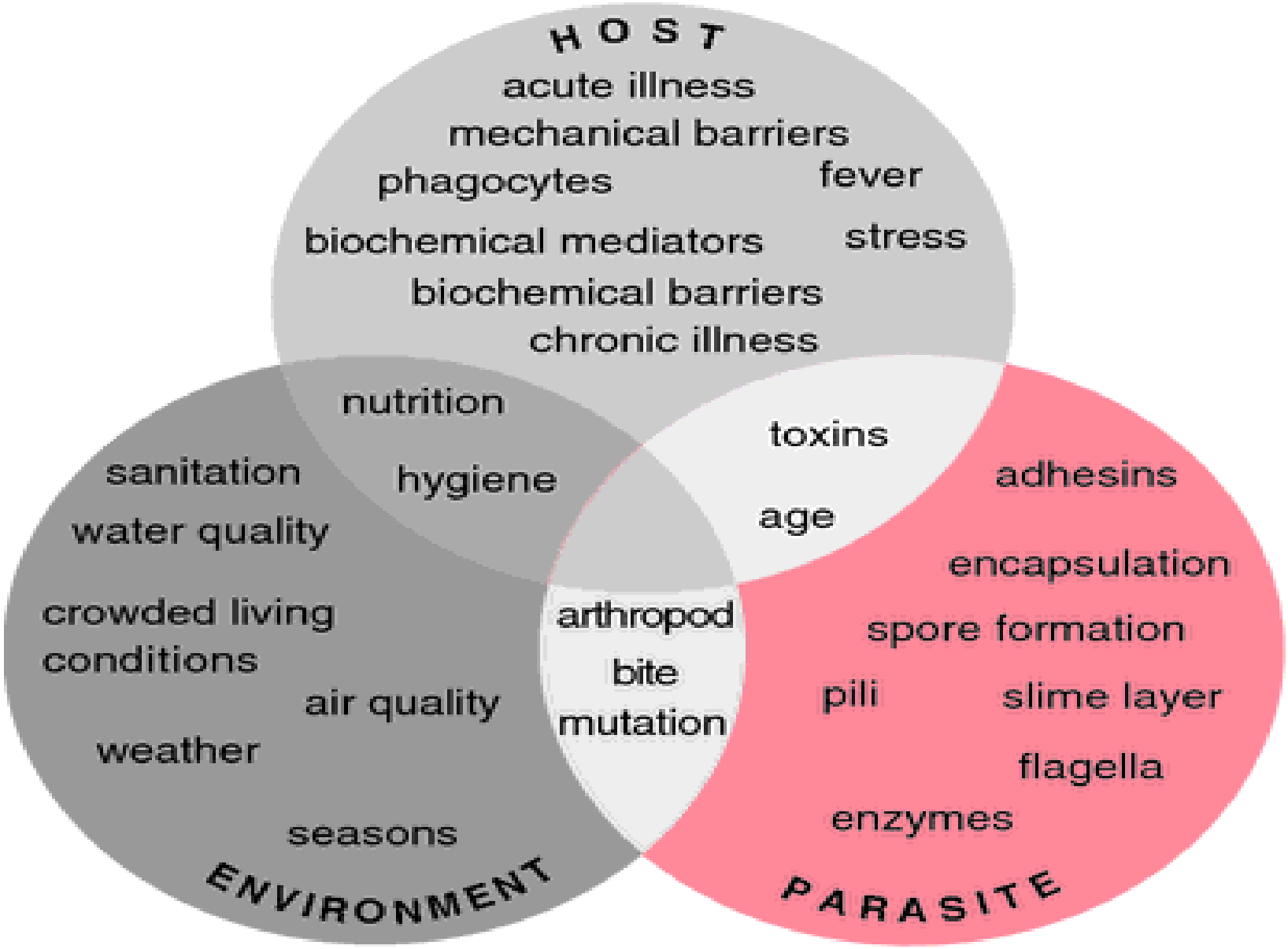
- Causes disease in immune compromised host
- Gain access (injury) to sterile regions




Protection
Disease
Normal flora
•Layer formation
•Waste product formation
•Immune stimulation
Pathologic flora
Normal flora
Pathologic flora
• Large inoculum
• Antimicrobial drugs
• Host factors
• Physical destruction

- When the organism is able to produce disease even in an apparently healthy host it is referred to as primary pathogen .

- When the organism causes disease only when the host's defenses are impaired, it is called secondary pathogen (opportunistic pathogen).


HOST
acute illness
mechanical barriers
phagocytes
fever
biochemical mediators
stress
biochemical barriers
chronic illness
nutrition
toxins
sanitation
hygiene
adhesins
water quality
age
encapsulation
crowded living conditions
arthropod bite mutation
spore formation
pili
slime layer
air quality
weather
flagella
enzymes
seasons
ENVIRONMENT
PARASITE

Pathogenicity :

Host Resistance To Parasite Invasion

1. Non specific defense :is part of natural constitution of the host. Examples:

- Skin mechanical barrier
- ciliated epithelium of respiratory tract
- Competition by normal flora
- Low pH in the stomach
- Cough
- peristalsis
- Lysozymes
- Neutrophils

2. Specific defense : is acquired resistance to certain organism: **e.g.** formation of Antibodies

Determinants of Pathogenicity

Before causing disease, the microorganism should have the ability to:

a) **Adhere:** the ability to attach firmly to host epithelial surface.

b) **Survive** host natural defense mechanisms**.**

c) **Multiply** to large numbers.

d) **Tissue Destruction:** the ability to overcome host defense , invade the tissues and cause destruction to produce clinical disease.

Adherence:

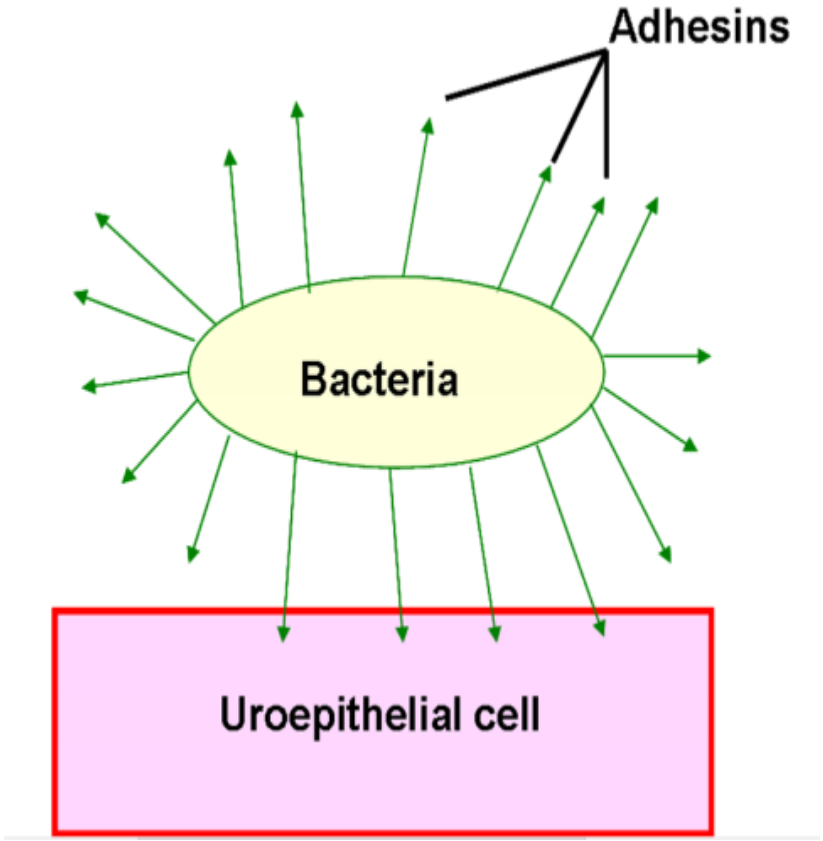
- By means of adhesins (attachment apparatus) found on bacterial surfaces.

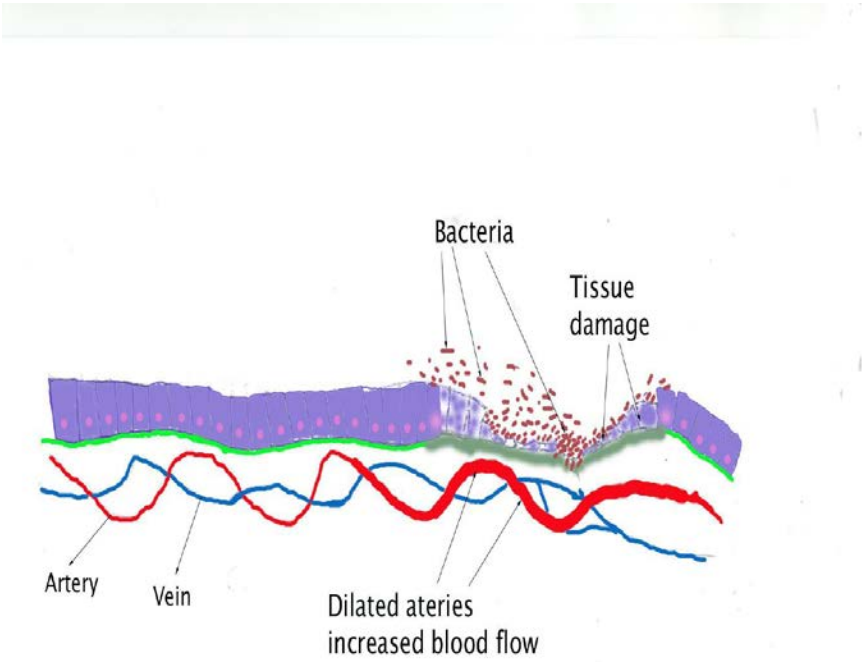
examples: **a) Pili**

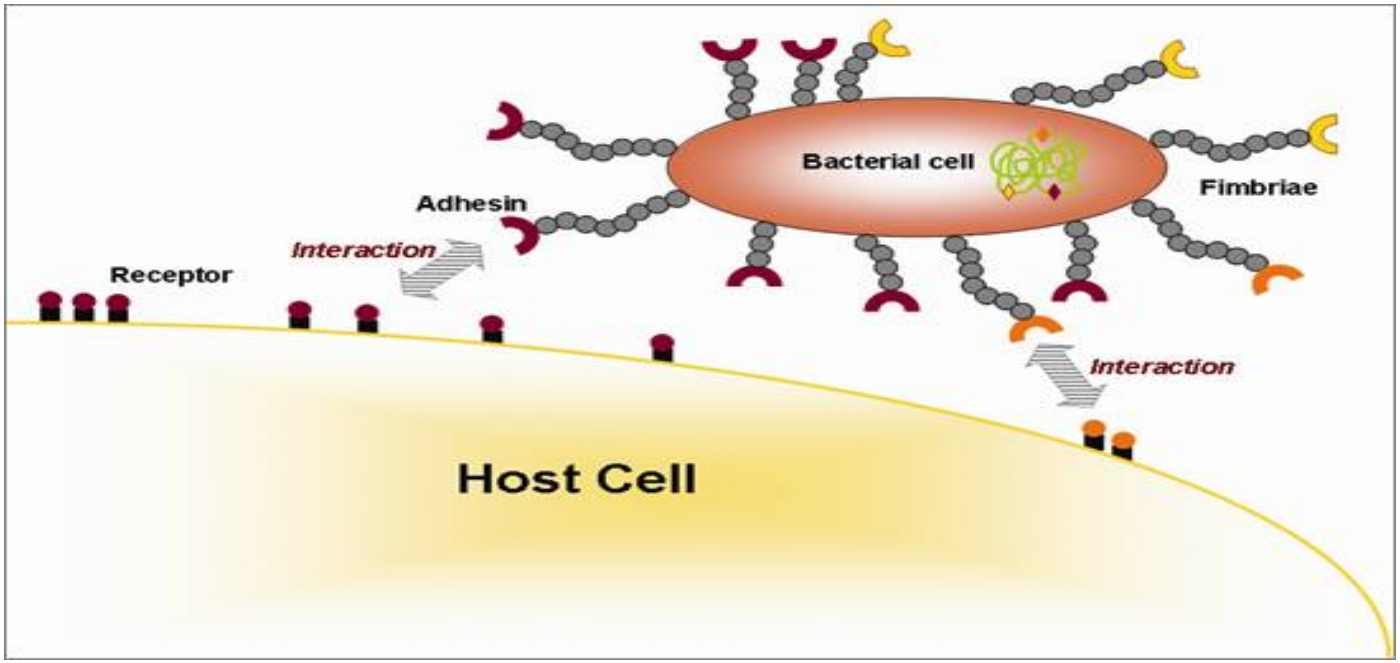
b) Other protein surface structures

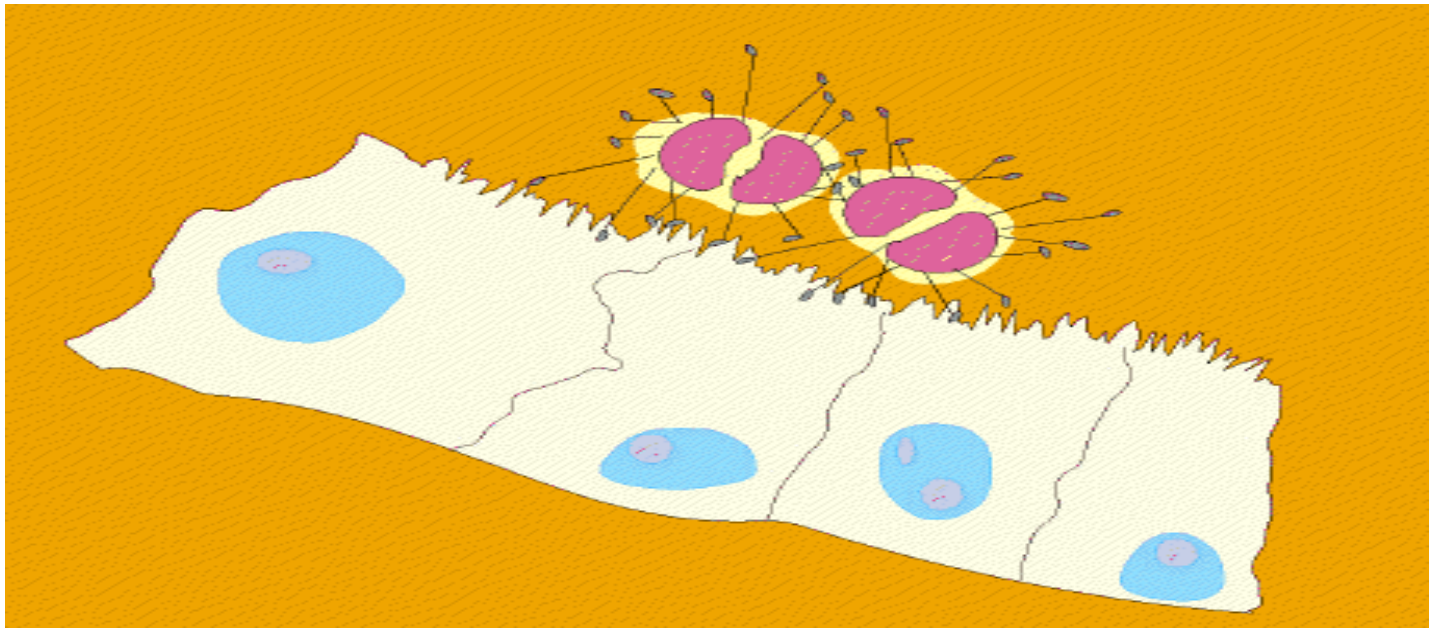
- Structures on host cells involved in adhesion include:
  - **a) Fibronectin**
  - **b) Proteins and Glycopeptide parts**

Adhesion& Tissue Destruction






Bacterial cell
Fimbriae
Adhesin
Interaction
Receptor
Interaction
Host Cell



Tissue destruction is produced by:

a) **Toxin** production ,either:

- Exotoxin: produced outside the gram positive and gram negative bacteria , or
- Endotoxin: only found in gram negative bacteria

b) Invasion by:

- Capsulated ,or
- Non-capsulated organisms

- **Capsulated organisms** : bacteria that have capsule.

Bacterial capsules are all made of **polysaccharide** except that of ***Bacillus anthracis*** (made of polypeptide).

Capsule prevents Phagocytosis.

- The organisms are readily killed once they are phagocytosed. So called extracellular organisms

  eg. ***Pneumococcus***

- **Non capsulated organisms** resist intracellular killing so called intracellular organisms.

  e.g. ***Mycobacterium tuberculosis, Salmonella typhi, Brucella*** **species, etc.**

- **Exotoxin** can be:

  a) **A – B type exotoxins eg.** Cholera toxins

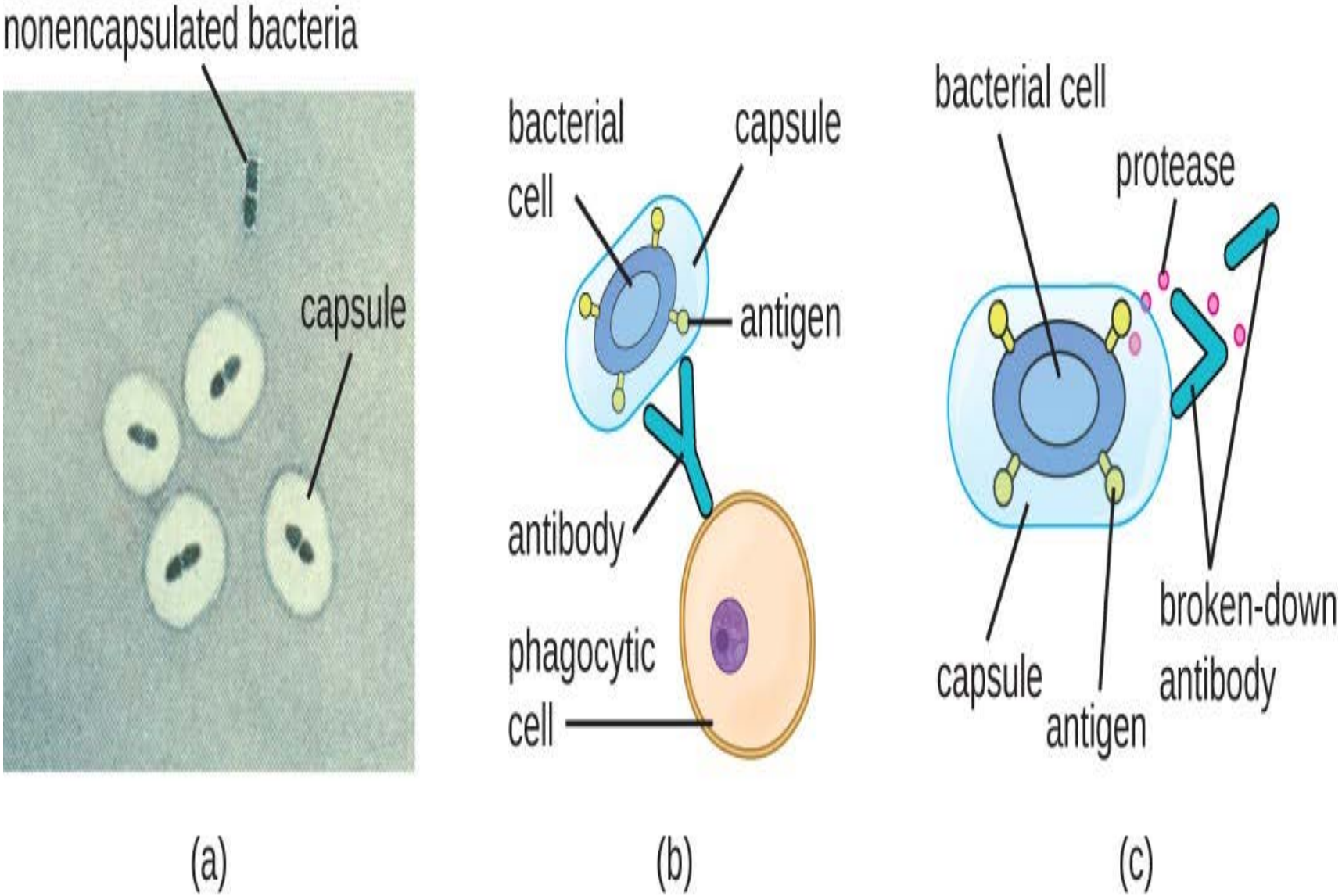
  A : Active unit

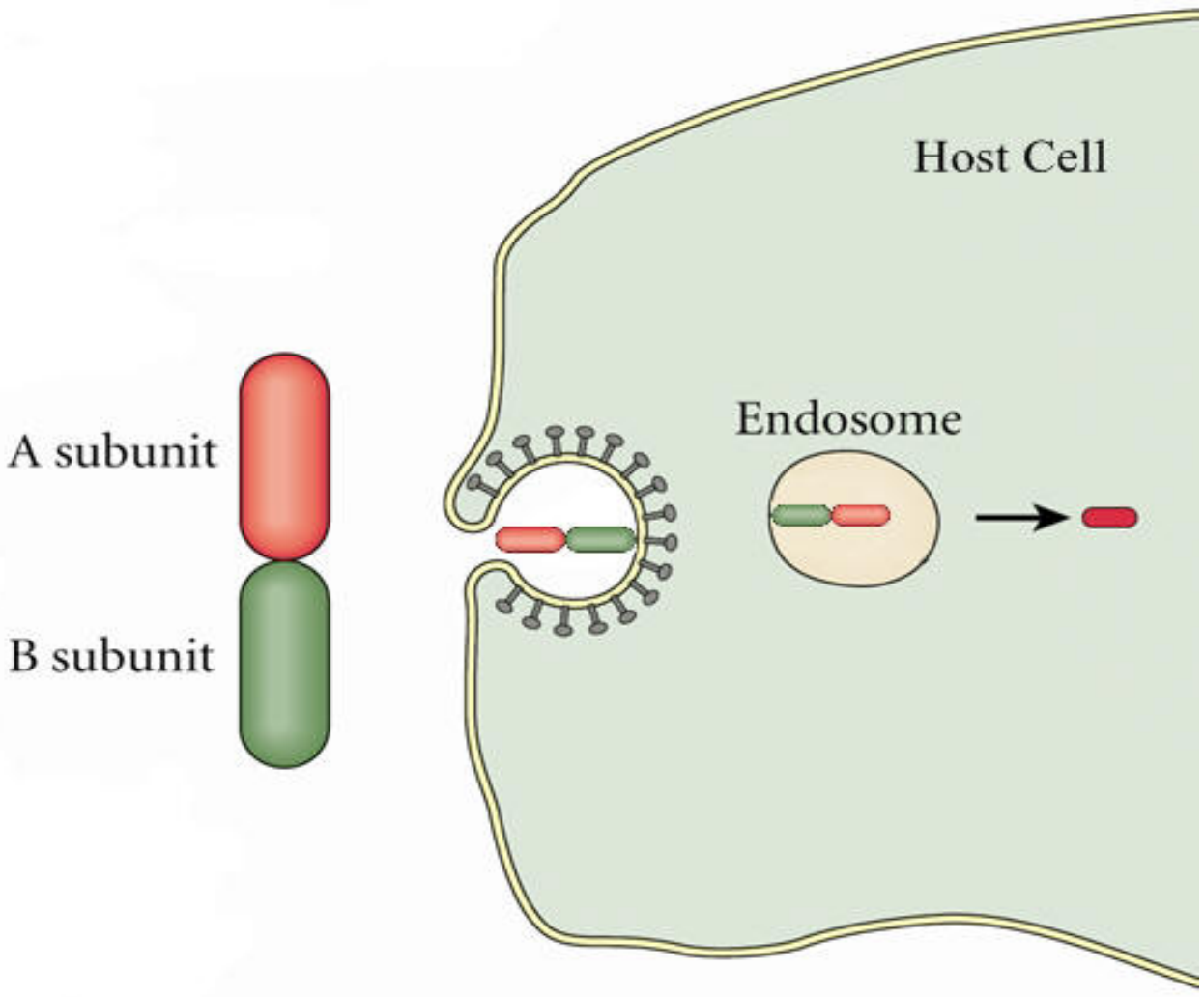
  B : Binding unit for attachment

Or:

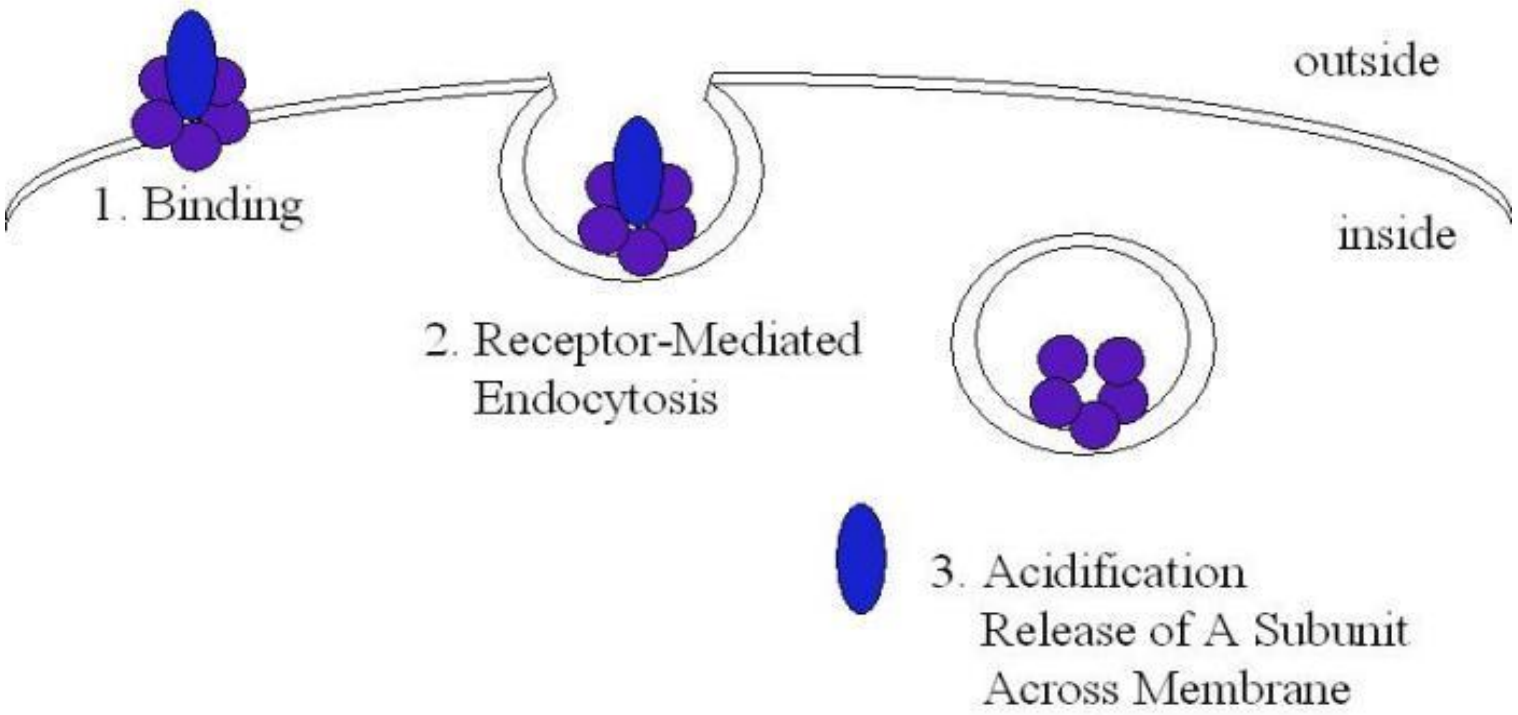
  b) **Membrane active exotoxin**

  eg. Haemolysin of group A Streptococci


nonencapsulated bacteria
capsule
bacterial cell
capsule
antigen
antibody
phagocytic cell
bacterial cell
protease
broken-down antibody
capsule
antigen
(a)
(b)
(c)


Host Cell
A subunit
B subunit
Endosome

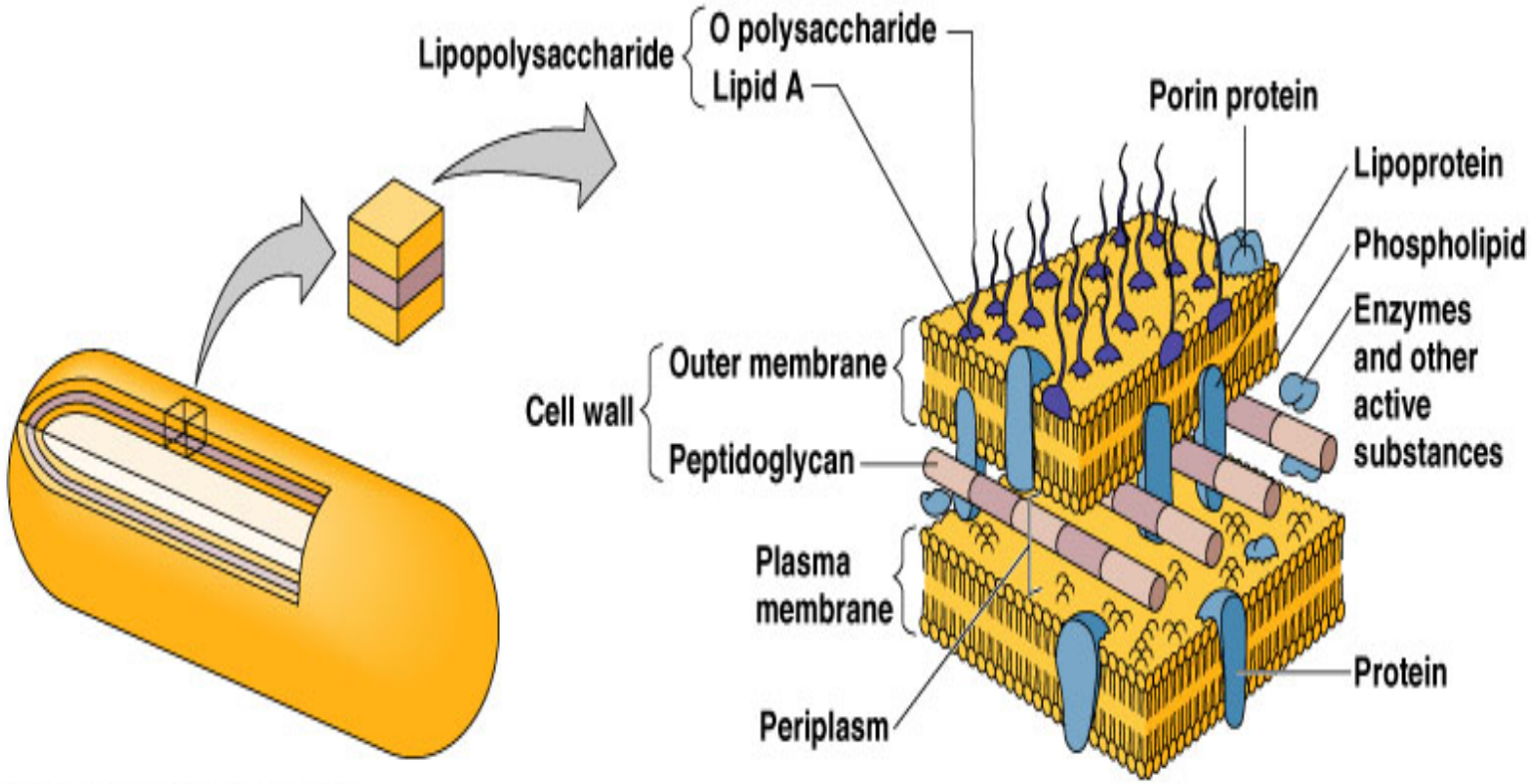
A-B Toxin Entry



Exotoxin *vs* Endotoxin

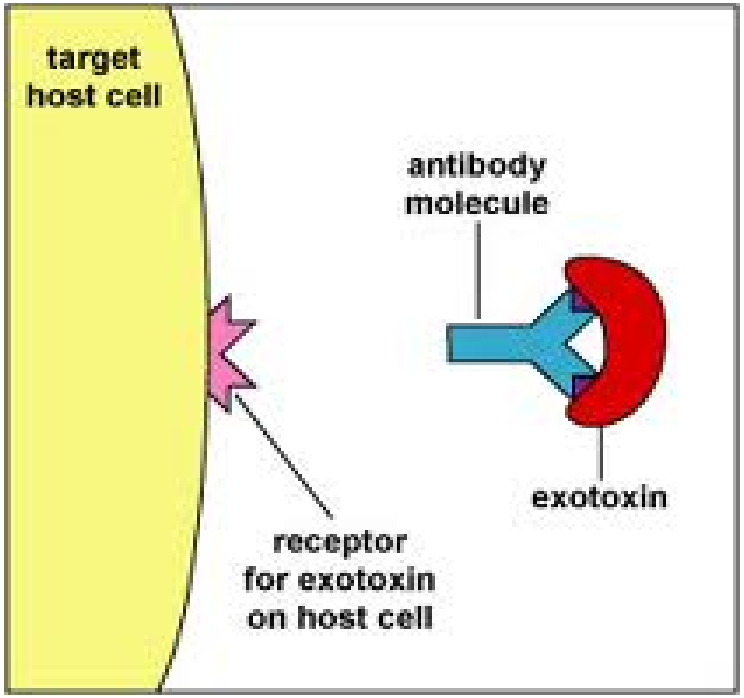
Exotoxin	Endotoxin
1- Protein	Lipopolysaccharide
2- Soluble	Part of cell wall
3- Heat Labile	Heat stable
4- Pharmacologically specific action	Non-Specific
5- High Immunogenicity	Low Immunognicity
6- Inactivated by chemicals to toxoids	Do not form toxoids
7- No Fever	Induce Fever

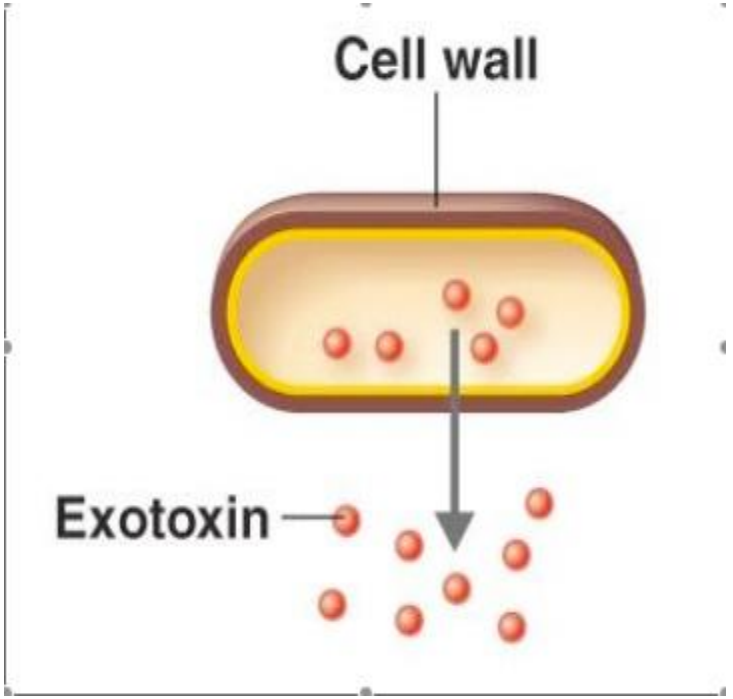
Endotoxin



(c) Gram-negative cell wall

Exotoxin


target
host cell
antibody
molecule
exotoxin
receptor
for exotoxin
on host cell


Cell wall
Exotoxin

Koch's Postulates

For an microorganism to be accepted as the cause of an infectious disease it must satisfy all or most of Koch's criteria.

Koch's Postulates

- In order to identify what organism causes a specific disease, certain rules are followed.
- Koch Postulates:

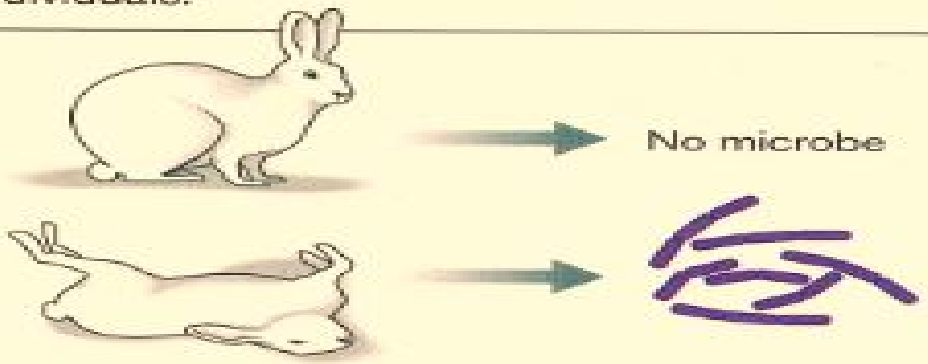
  1) pathogen must be found in subject with disease but never in a healthy subject

  2) pathogen can be isolated from sick person and grown in lab

  3) pathogens injected into healthy person will cause the individual to become infected with the same disease

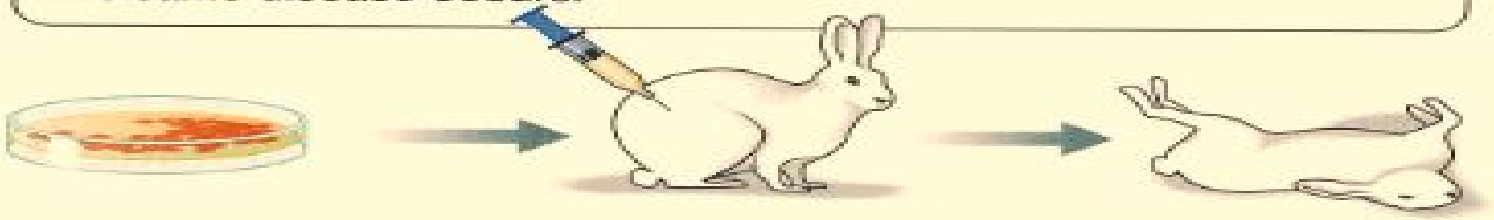
  4) injected pathogens can be isolated from newly infected individual and are identical to original pathogens

1. The microbe is found in all cases of the disease but is absent from healthy individuals.



2. The microbe is isolated from the diseased host and grown in pure culture.

3. When the microbe is introduced into a healthy, susceptible host, the same disease occurs.



4. The same strain of microbe is obtained from the newly diseased host.